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ABUNDANCE OF SEALS IN THE EASTERN BEAUFORT SEA, AMUNDSEN GULF AND PRINCE ALBERT SOUND, 1982

BY M.C.S. KINGSLEY
AND N.J. LUNN

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M.C.S. KINGSLEY
Canadian Wildlife Service
and N.J. LUNN
Department of Zoology, University of Alberta

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ABSTRACT

Kingsley, M.C.S. and N.J. Lunn. 1982. The abundance of seals in the Beaufort Sea, northern Amundsen Gulf and Prince Albert Sound, 1982. Report prepared for Dome Petroleum Limited and Gulf Canada Resources Inc. Canadian Wildlife Service, Edmonton. v + 16pp.

The second of a series of monitoring surveys was flown in the Beaufort Sea off the Tuktoyaktuk Peninsula and the Mackenzie Delta, in northern Amundsen Gulf and in Prince Albert Sound.

Ice cover in the Beaufort Sea was restricted to a narrow strip of fast ice along the mainland coastline. The density of ringed seals was higher there than in 1981, and the estimated population very similar. Regressions of ringed seal density on habitat factors did not show any changes in density that could be attributed to hydrocarbon exploration.

Amundsen Gulf and Prince Albert Sound were covered with 8/8 fast ice. High densities of ringed seals were seen throughout these areas, with some very dense concentrations near the western end.

Bearded seals occurred along the seaward edge of the landfast ice in the Beaufort Sea, and on small floes further out, in larger numbers than in 1981.

INTRODUCTION

It is expected that exploration for and development of hydrocarbon resources in the Beaufort Sea will eventually increase, and may reach high levels of activity. With this in mind, a series of aerial surveys for ringed seals *(Phoca hispida)* and bearded seals *(Erignathus barbatus)* was started in 1981, to monitor for possible effects of this increased industrial development on these species. These surveys follow in the footsteps of a series flown over the Beaufort Sea in 1974 and 1975 as part of the Beaufort Sea Project, and continued through 1979 to study the recovery from a crash in the populations which occurred in 1975 (Stirling *et al*. 1982). However, they cover a smaller area in the Beaufort Sea – only the waters offshore from the Tuktoyaktuk Peninsula and the Mackenzie Delta – but they are more intensive within that area and include for comparison a control area: northern Amundsen Gulf and Prince Albert Sound, known from previous work to hold high densities of ringed seals (I. Stirling, personal communication; T. Smith, personal communication; Kingsley *et al*. 1982b).

METHODS

Survey area

The survey area was the same as in Kingsley *et al.* (1982a). Stratum 1 includes the waters offshore from the Tuktoyaktuk Peninsula and the Mackenzie Delta from 129° 15'W to 136° 30'W (Fig 1). The transects in this area are oriented north–south and are spaced 15' of longitude apart; the target length for the transects was 160 km, but the northern ends were adjusted to the nearest 20' of latitude.

Stratum 2 consists of the northern part of Amundsen Gulf, as far south as 70° 30'N and as far west as 123° 00'W. In this area, and in stratum 3, which comprises Prince Albert Sound and the mouth of Minto Inlet, the transects are spaced 20' of longitude apart, to fit in with the transects of the high Arctic survey which covered part of this area in 1980 and 1981 (Kingsley *et al.* 1982b). Strata 2 and 3 are high–density areas for ringed seals, and are favoured by Inuk seal hunters.

Survey flying

The survey, as in previous years, was flown at 500 ft (152.4m) in a Cessna 337 'Skymaster' at its usual cruising speed of about 140 knots (72.02 m/s). If visibility was poor, the altitude was reduced to 300 ft (91.4 m). Marked wing struts enabled the transect line to be divided into inner and outer 1/8 mile strips on each side of the aircraft (Kingsley *et al.* 1982b; Stirling *et al.* 1982). Owing to previous commitments of one of the observers, and to delay in the availability of the aircraft, the survey started a little later than in previous years, on 19 June 1982. However, a reduced survey area, due to early breakup in the Beaufort Sea, and generally favourable weather, allowed us to complete the flying by 24 June. In 1981, the survey had started on 15 June, and had been completed on 22 June.

Data collected was the same as in 1981, except that a thickness variable was recorded for the ice as well as the cover, age and condition variables recorded previously. Both observers recorded ice cover; one observer also recorded sky condition, wind speed and the presence of fog while the other recorded ice age, condition and thickness.

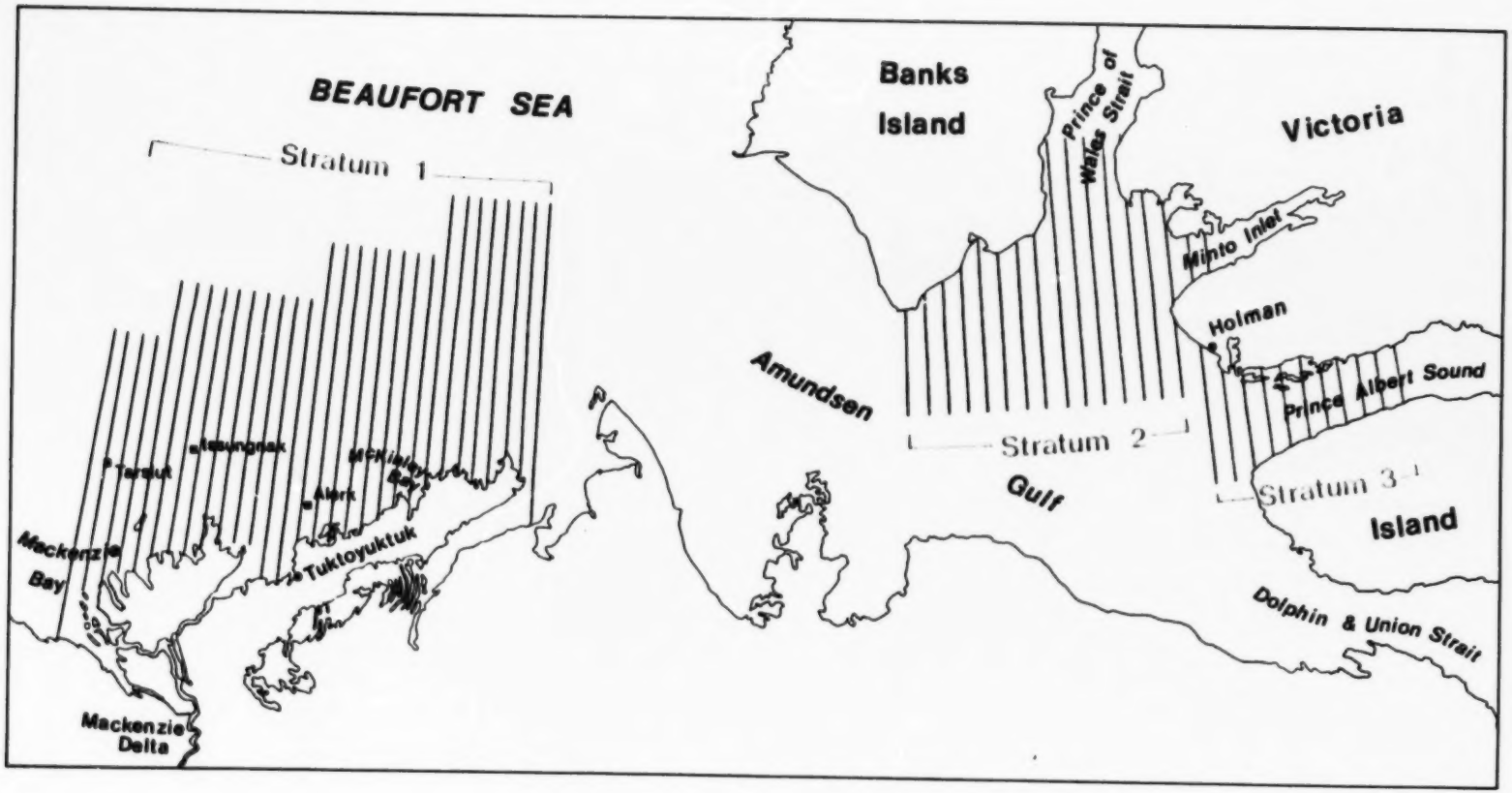

Figure 1. Survey area, strata and transects, Beaufort Sea and Amundsen Gulf, 1982

As in previous years, we identified to species and recorded all hauled-out seals on the transect. As well, seal holes were recorded.

Data analysis

The mean densities of seals and of seal holes, in the three strata surveyed, were calculated using the methods of analysis described in Kingsley *et al*. (1982b). We used seal hole counts for the inner strips only, because the previous experience had shown that observers could differ widely in their recorded densities of holes in the outer strip (M. Kingsley, unpublished data).

Thirteen exploration sites (wells, borrow areas and logistic bases) were identified which had been active for some period of the 12 months before the survey. The distance from each two-minute interval to each site was calculated, and from that a proximity

$$F(ij) = 1/(2+d(ij))$$

where F(ij) is the proximity of the i-th site to the j-th interval (km^{-1}) and d(ij) is the distance from the i-th site to the j-th interval (km). Habitat regressions used, in addition to the ice-type and -cover and water-depth variables used in other studies (Kingsley *et al*. 1982b) the sum of the proximities Sum/i (F(ij)) and their maximum Max/i (F(ij)). These variables were offered as candidate variables in stepwise regressions after significant habitat effects had been established.

RESULTS AND DISCUSSION

Survey quality

The weather for the survey was generally good. A bank of fog which persisted over the open water offshore from the fast ice in the Beaufort Sea occasionally invaded the survey area, and one flight in Prince Albert Sound was troubled by strong northerly winds, but apart from this, we had light winds and relatively high temperatures.

As in previous years, the same observers sat on the same sides for the whole time. When the densities recorded in the various strips are compared (Table 1), it is seen that the right observer showed higher densities than the left, perhaps because of greater experience. The right observer obtained a higher density in the outer strip than in the inner, which is in accordance with previous results in this kind of survey, but the left observer got the reverse result. However, none of these differences were statistically significant.

Table 1. Seal densities recorded, by strip, Beaufort Sea and Amundsen Gulf, 1982

Left observer		Right observer	
outer	inner	inner	outer
1.78	1.96	2.02	2.20

– densities in seals/km²; 6/8+ cover, no fog, complete two-minute intervals only.
– the approximate error variance for comparing strip densities is 0.0219.

Ice conditions

The ice in the Beaufort Sea broke up unusually early in 1982, and when we flew the survey, only a narrow band of shore-fast ice remained (Fig. 2). Outside that was open water, with variable cover of small floe and brash ice. At the eastern end of the Beaufort Sea stratum, large to gigantic floes drifted into the study area from an ice edge between Cape Lambton and Cape Parry, so that

the ice cover on a transect could vary from day to day.

Amundsen Gulf, which in 1981 had opened up before we had started the survey, in 1982 was still fast ice (Table 2, Fig. 3). An ice edge ran from near Cape Lambton – the southern point of Banks Island – to Cape Parry, with open water to the west. The fast ice was starting to crack near this ice edge.

Ringed seal density

The density of ringed seals on the fast ice in the Beaufort Sea was low (Table 3). A similar result was obtained in 1981, when the average density of ringed seals in the stratum was 0.15/km² – one-third of the 1982 value – but most of them had been seen on the offshore pack, and few on the shore-fast ice (Kingsley *et al.* 1982a: Fig 4). It seems from these results that the shore-fast ice off the Tuktoyaktuk Peninsula is less used by ringed seals than fast ice in Amundsen Gulf and in the high Arctic (Kingsley *et al.* 1982a, b), perhaps because of the shallow and somewhat turbid water. A six-year series of surveys showed, by regression of density on habitat variables, that shallow water is consistently avoided by ringed seals (Stirling *et al.* 1982). The ringed seals seen in 1982 tended to be near the offshore edge of the fast ice (Fig. 4). The population estimates extrapolated from the survey data of 1981 and 1982 were very close (Table 3).

Densities in Amundsen Gulf and Prince Albert Sound were not as high as in 1981, but were, nevertheless, quite high. The population estimated for stratum 3 – Prince Albert Sound – was very similar to that for 1981, when Amundsen Gulf had been open: the lower density compensated for the greater ice area. In stratum 2 the population estimate was nearly 4 times as high as in 1982: the much greater ice area was not compensated by a density only 15% smaller. There is some evidence from the plot of seal density (Fig. 4) of local concentrations toward the western side of the stratum, but densities are also high in some other areas. These results show that the high densities found in 1981 may not have been solely due to the low ice cover in that year, but may be a recurrent feature of these areas. However, these densities are high compared with those obtained in other surveys (Smith 1973; Alliston and McLaren 1981; Kingsley *et al.* 1982b).

Figure 2. Open water and partial ice cover, Beaufort Sea and Amundsen Gulf, 1982

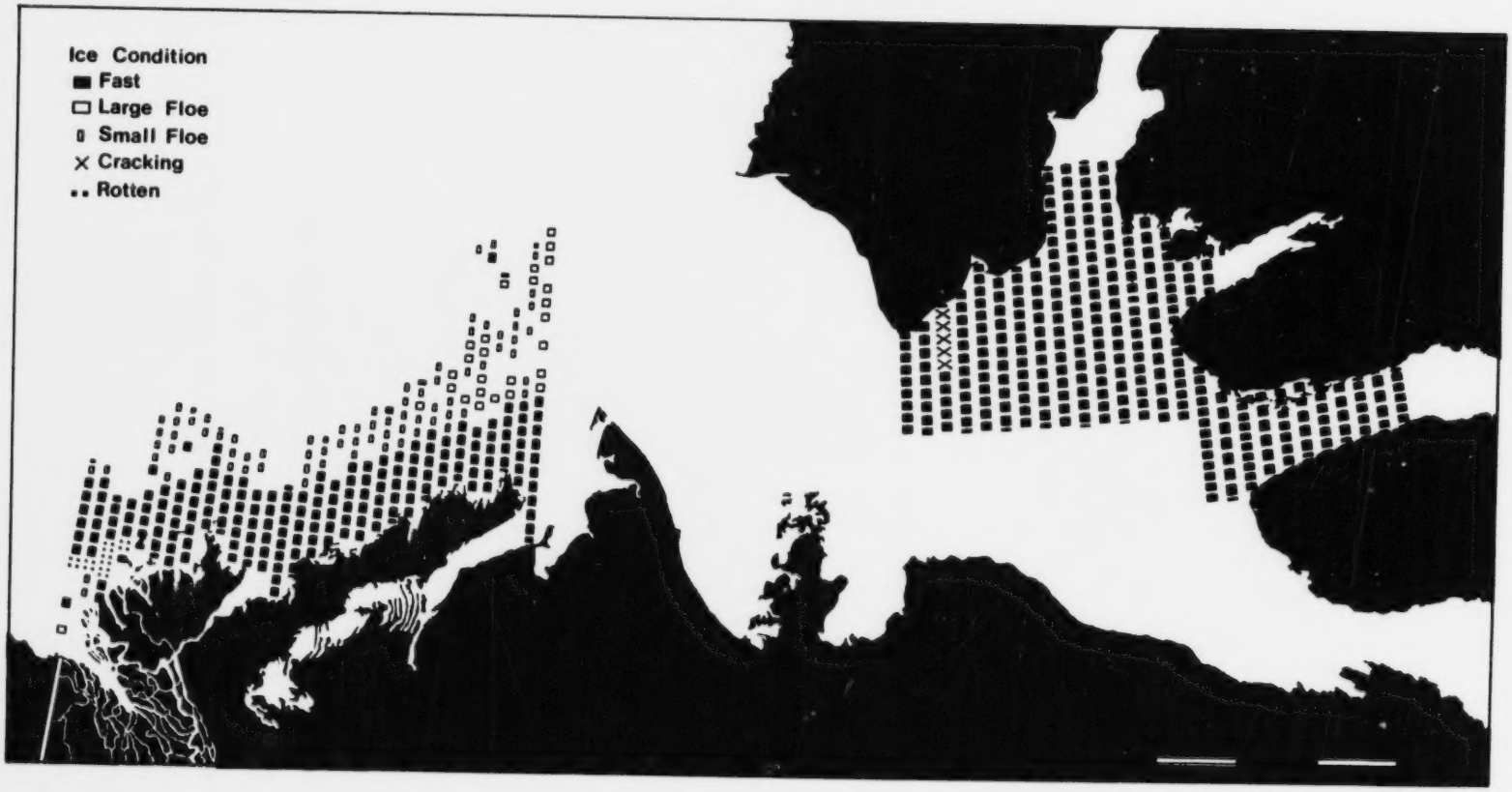

Figure 3. Ice condition, Beaufort Sea and Amundsen Gulf, 1982

Table 2. Ice cover and condition, Beaufort Sea and Amundsen Gulf, 1981–1982

Stratum:	1		2		3	
Year:	1981	1982	1981	1982	1981	1982
Area[1] (km^2)	47312	47454	21027	21274	7371	7406
Percentage area						
Ice cover (/8)						
0	4.8	49.9	74.3	0.0	31.3	0.0
6+	76.3	28.3	21.6	100.0	66.2	100.0
8	17.9	16.4	11.4	100.0	58.3	98.4
Ice surface	74.2	31.0	22.2	99.9	65.1	99.8
Ice condition[2]						
Fast and cracking	12.2	65.4	46.7	100.0	92.6	100.0
Floe	68.0	34.6	41.1	0.0	0.0	0.0

[1]stratum areas were calculated from transect lengths and spacings, and therefore vary slightly from year to year.
[2]percentage areas were calculated as a percentage of the area with any ice cover.

Habitat regressions and the effect of disturbance

When ringed seal density was regressed on habitat factors, the only variable that entered was 'fast ice', with a positive coefficient. This was expected: fast ice is a habitat type that has been shown often in regressions of this type to be preferred by ringed seals (Kingsley *et al*. 1982b; Stirling *et al*. 1982). Neither the sum, nor the maximum, of the disturbance proximities had any additional effect. When the disturbance proximity variables were offered at the same time as the habitat variables, the sum of the proximities entered with a positive coefficient, and prevented the 'fast ice' variable from entering the regression. This result should not be interpreted as meaning that ringed seals prefer disturbed areas. A more sensible interpretation is that most of the disturbance sites are far enough offshore to be close to the edge of the strip of landfast ice, where the highest densities of seals were, perhaps for other reasons, to be found. In the absence of any variable

Table 3. Seal densities and estimated populations, Beaufort Sea and Amundsen Gulf, 1981–1982

	Stratum	Density (standard error)		Estimated population(10^3)	
		1981	1982	1981	1982
Ringed seal[1]	1	0.150 (0.012)	0.415 (0.063)	5.4	5.5
	2	3.083 (0.663)	2.610 (0.259)	14.0	54.9
	3	3.458 (0.672)	2.032 (0.205)	16.9	15.0
	2–3	3.277 (0.463)	2.459 (0.197)	30.9	70.5
Bearded seal[2]	1	2.051 (0.306)	8.680 (1.375)	0.72	1.27
Seal holes[3]	1	–0[4]	–0		
	2	3.743 (0.538)	3.600 (0.179)		
	3	4.538 (0.647)	3.613 (0.225)		
	2–3	4.253 (0.450)	3.603 (0.146)		

[1]ice cover 6/8–8/8, no fog; densities and standard errors in seals/km^2
[2]any ice, no fog; densities and standard errors in seals/ 100km^2 ice
[3]fast ice, no fog; data from inner strips only included; densities and standard errors in holes/km^2
[4]owing to puddling, thaw holes, and the dirtiness of the ice, it was difficult to count seal holes accurately in the fast ice off the Tuktoyaktuk Peninsula in both 1981 and 1982; counts are thought to be too unreliable to be included

explicitly measuring distance from the shore, disturbance proximity was pulled into the regression to fulfil that function. This perhaps shows that the greatest density of activity is tending to take place along the shear zone where seals tend to be most abundant.

Densities of seal holes

We found it impossible to count seal holes accurately in stratum 1, because of the frequency of thaw holes and the often–discoloured ice. In strata 2 and 3 conditions for counting holes were good: the ice was bare of snow cover, and the surface was wet, so that holes were quite easy to see. The only factor that may have conduced to under–recording of holes was the high densities of seals in these areas. Strata 2 and 3 had high densities of holes (Table 3), but not as high as the high densities of seals would be expected to produce; the ratio of holes to seals was

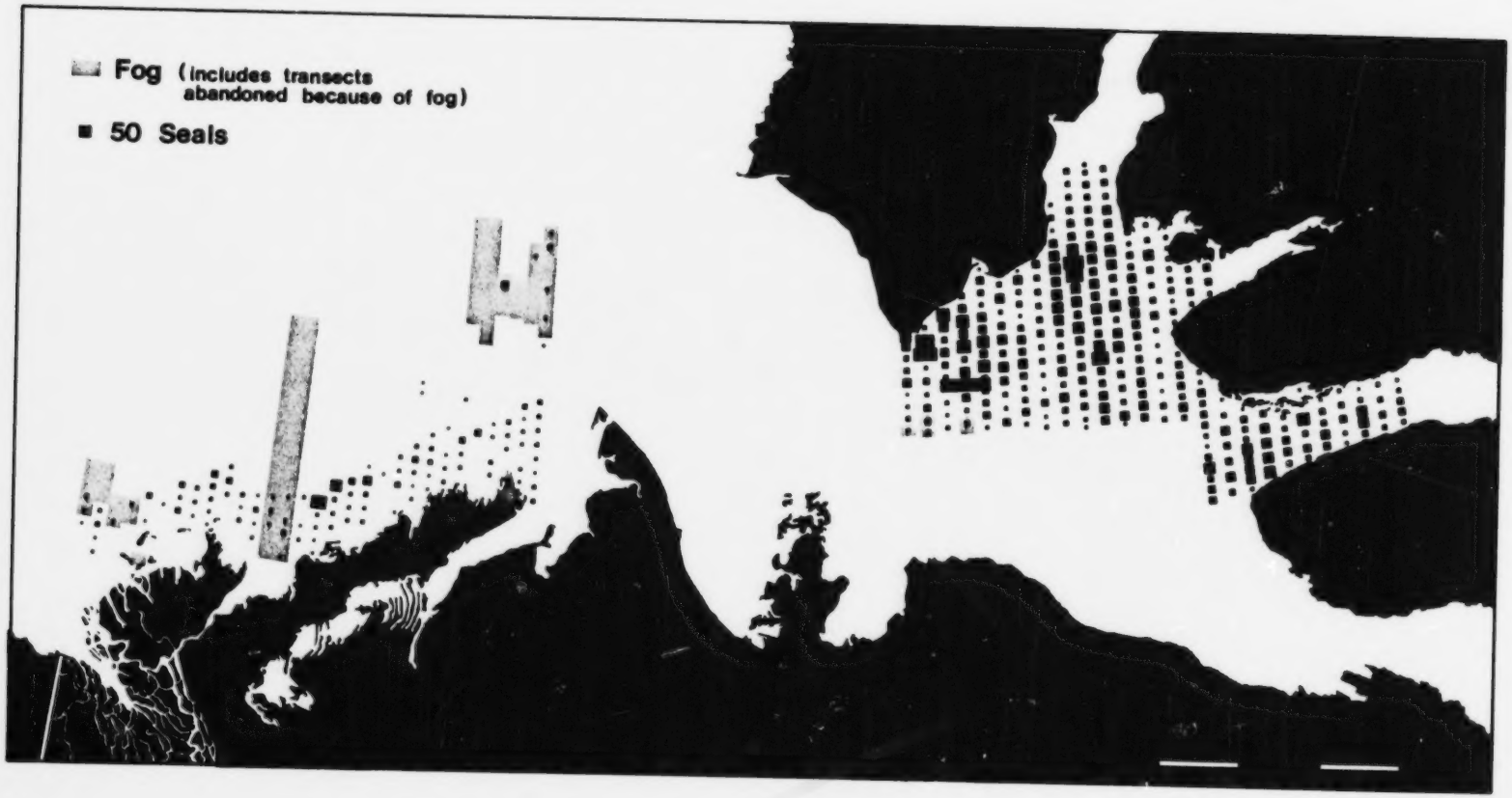

Figure 4. Observations of ringed seals, Beaufort Sea and Amundsen Gulf, 1982

lower (1.4 in stratum 2; 1.8 in stratum 3) than had been found in high-density areas in the high Arctic (values of 4 to 10 were found in high Arctic strata 5 and 6: Kingsley *et al*. 1982b). These low values are more like those found in low-density areas in the high Arctic. It is a feature of ringed seal existence that more than one hole should be available for a seal to be able to avoid being waited out by a polar bear; this would argue for a minimum hole ratio of 2 under winter conditions (unless holes are shared – say between males and females) and a higher ratio would be expected.

At least some of the high density of seals in stratum 2 was due to seals' having moved into the stratum from the early open water to the west: we saw several large congregations of seals toward the western end of the stratum. When the seal distribution (Fig 4) is compared with that of seal holes (Fig 5) it can be seen that the high-density area in the middle of stratum 2 shows on both, but the high densities of seals near the western end of stratum 2 are not reflected by seal hole densities.

Bearded seals

Bearded seals like to haul out on ice floes. (Ringed seals don't, and are never to be seen on floe edges, though they do occasionally use holes and cracks in the middle of large floes.) We saw many bearded seals on this survey, especially on small floes at the eastern end of stratum 1; sometimes as many as eight or ten would be arranged radially round the edges of a floe.

Comparison of Figs. 3 and 6 shows that the bearded seals were found at the edge of the fast ice – usually on the strip of floes to be found there – or further offshore; at any rate, further offshore than the ringed seals, whose distribution tended to stop at the edge of the fast ice. The counts of bearded seals were higher than had been obtained in previous years; the population estimate extrapolated from the sightings in stratum 1 was nearly twice that for 1981 (Table 3), but, as previously, they were largely absent from the fast ice of strata 2 and 3.

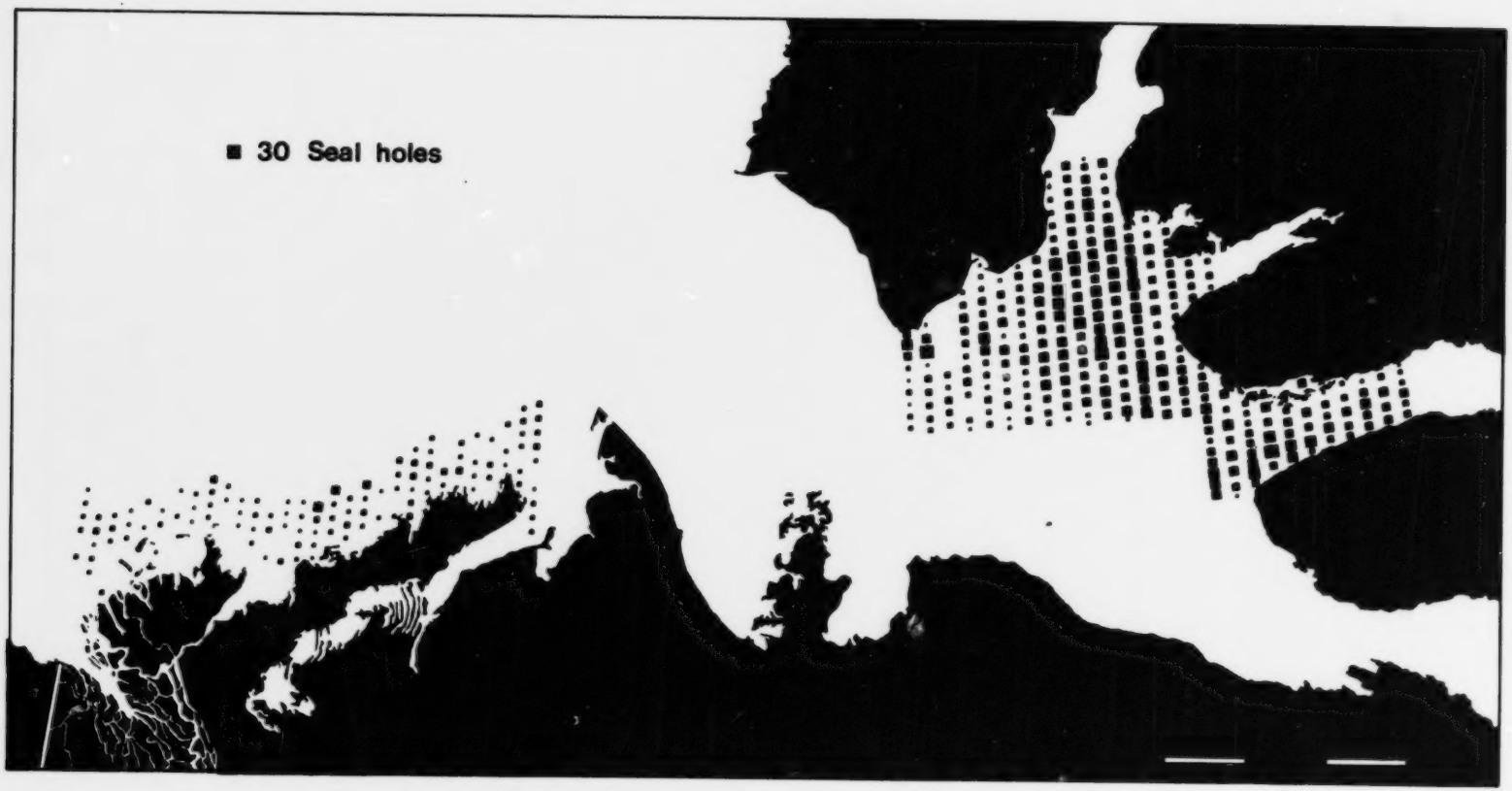

Figure 5. Observations of seal holes, Beaufort Sea and Amundsen Gulf, 1982

Figure 6. Bearded seal observations, Beaufort Sea and Amundsen Gulf, 1982

CONCLUSIONS

The most significant conclusion emerging from this survey, and its comparison with that of 1981, relates to the seal populations in Amundsen Gulf and Prince Albert Sound. The high densities recorded there in 1981 now seem not to have been related to the early open water, being repeated in 1982 when there was complete ice cover, and may be a feature of the seal population there. Evidence against this is a recorded density of seal holes not high enough to agree with the seal densities obtained. It is *prima facie* implausible that that an Arctic ecosystem can maintain, all year round, 2 or 3 large carnivores per square kilometre. However, if these results can be confirmed by future repetitions of these surveys, they will strikingly emphasize the relative productivity of Arctic marine ecosystems and the importance of protecting them.

The survey results from the Beaufort Sea stratum confirmed the generally low population density of ringed seals in that area, and showed no density reductions attributable to hydrocarbon exploration.

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